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Qualité, économie, progrès social, environnement”**

**“What is the future of Agriculture in the Caribbean ?  
Quality, Economy, Social Progress, Environment”**

**“¿ Cuál es el futuro de la Agricultura en el Caribe ?  
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## FERTILIZER MANAGEMENT EFFECTS ON FORAGE AND SEED YIELD OF TROPICAL GRASSES IN THE U.S VIRGIN ISLANDS

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### RESUME

L'herbe de Guinée (*Panicum maximum* Jacq.), important fourrage tropical dans les îles de la Caraïbe de l'est, est installée par graine. La faible disponibilité en semences, due aux pertes importantes et à la faible germination, est un facteur limitant majeur au développement de pâturage. La récente introduction d'Atra paspalum cv "Suerte" (*Paspalum atratum* Swallen) a fait apparaître un potentiel comme fourrage de remplacement, mais davantage d'informations sont nécessaires sur le rendement en matière sèche et en semences. Une expérimentation au champ fut conduite sur une argile légèrement alcaline Fredensborg (finement carbonique, isohyperthermique, Rendols typique, Mollisols) en 2000 afin de déterminer l'effet sur le rendement en matière sèche et en semences de trois doses d'azote (0, 56 et 112 kg à l'hectare). Le nitrate d'Ammonium comme source d'azote était appliqué à la volée sur les souches (15 cm de hauteur de chaume) de l'herbe de Guinée et de "Suerte" au début du mois d'août et récolté au mois de novembre (durée de douze semaines). L'herbe de Guinée et le "Suerte" ne différaient pas en rendement de matière sèche ( $P < 0,05$ ). Il y avait, cependant, un effet azoté linéaire ( $P < 0,05$ ) sur les rendements de matière sèche. Le rendement de matière sèche de l'herbe de Guinée était en moyenne de 6,5, 8,3, et 9,3 tonnes à l'hectare, et pour le "Suerte" de 6,1, 8,6, et 10,5 tonnes à l'hectare pour respectivement 0, 56 et 112 kg d'azote à l'hectare. Les doses d'azote n'affectaient pas le rendement en semence de l'herbe de Guinée ( $P < 0,05$ ), (0,12 tonne à l'hectare) ou de "Suerte" (0,23 tonnes à l'hectare). Il y avait une variation sur la germination des semences chez les deux fourrages. De forts vents d'Est (les alizés) ont aussi affecté les rendements des deux fourrages en l'an 2000. Pour obtenir plusieurs récoltes pour ces fourrages, il est nécessaire de pouvoir mieux estimer le rendement et la qualité de la semence.

### ABSTRACT

Guineagrass (*Panicum maximum* Jacq.), an important tropical forage in the eastern Caribbean Islands is established from seed. Low seed availability due to seed shattering losses and low germination percentages limits pasture development in the U.S. Virgin Islands. Recent introduction of Atra paspalum cv. Suerte (*Paspalum atratum* Swallen) exhibited potential as stand-over forage, but more information is needed on dry matter yield (DMY) and seed yield. A field experiment was conducted on a mildly alkaline Fredensborg clay (fine carbonatic, isohyperthermic, Typic Rendols, Mollisols) in 2000 to determine the effect of three N rates (0, 56, and 112 kg ha<sup>-1</sup>) on DMY and seed yield of guineagrass, Bluegrass, and Suerte. Ammonium sulfate as N source was broadcast applied on cut grass stands (15-cm stubble height) on 15<sup>th</sup> August 2000 and harvested in November 2000 (12 wk). Guineagrass and Suerte differed in DMY ( $P < 0.05$ ). There was also an N linear ( $P < 0.05$ ) effect on DMY for guineagrass, but not for Suerte. Guineagrass DMY averaged 6.5, 8.3, and 9.4 Mg ha<sup>-1</sup> for the 0, 56, and 112 kg ha<sup>-1</sup> of N, respectively. Suerte averaged 2.56 Mg ha<sup>-1</sup>. Seed yield of guineagrass compared to Suerte was not different ( $P > 0.05$ ). Seed yield of guineagrass was 242 kg ha<sup>-1</sup> and Suerte was 278 kg ha<sup>-1</sup>.

There was a trend for seed increase with increasing N rates for guineagrass ( $P=0.10$ ) and a quadratic response ( $P<0.05$ ) for Suerte. Results of the study indicate a strong response of guineagrass to N applications. During seed maturity, strong easterly winds may have affected yields of both grasses. Multiple harvests may be needed for these grasses to get a better estimate of seed yield and quality.

## INTRODUCTION

Guineagrass (*Panicum maximum* Jacq.) is one of the most widely used tropical grass in the eastern Caribbean islands. It is well adapted to seasonally dry and neutral to alkaline soils. Key attributes are high forage yield and excellent nutritive value (Oakes, 1966). It is the base feed source for livestock and hay production in the U.S. Virgin Islands, but low standards of grassland management (i.e., over-grazing) has resulted in extensive stand degradation. Preliminary studies indicate that with proper management, guineagrass stands can regenerate with N application and from seed reserves. Rehabilitation of degraded pastures and planting of new pastures, however, require that seeds be readily available.

Nitrogen is an essential nutrient for forage and seed production. Work by Caro-Costa *et al.* (1960) reported that in the humid mountainous region of Puerto Rico, guineagrass forage DM doubled with applications of 200 lbs of N acre  $\text{yr}^{-1}$ . A review by Loch *et al.* (1998) reported that tropical grasses are dependent on soil fertility and amount of N applied for forage and seed yield. Recent work by Kalmbacher *et al.* (1999) reported quadratic increases in annual yield (2947, 4331, 6742, and 7854 lbs acre $^{-1}$  of cv. Suerte with increasing single N applications (50, 100, 200, and 300 lbs acre $^{-1}$ ). Adjei *et al.* (1992) found that N (45 lbs acre $^{-1}$ ) increases tiller density and number of inflorescence in bahiagrass (*Paspalum notatum* Flugge).

Both guineagrass and Suerte seed in late September and October. This corresponds to the rainy season in the U.S. Virgin islands. Valencia *et al.* (2001) assessed N rates and closure date effects on seed yield of guineagrass. They reported linear increases in yield with increasing N rates. Closure date (removal of cattle from grazing) did not affect seed yield. They concluded that cutting or grazing guineagrass as late as mid-August would not affect seed yield. Work by Kalmbacher *et al.* (1995), however, reported that rest periods (regrowth after grazing) affected seed yield of Suerte. They reported that uncut Suerte seed yield was the highest (219 kg ha $^{-1}$ ). More information is needed on N rate effects on both forage and seed yield of Suerte in the U.S. Virgin Islands.

The objective of this study was to determine the effect of three N rates (0, 56, and 112 kg ha $^{-1}$ ) on forage DMY and seed yield of guineagrass, Bluegrass and Suerte.

## MATERIALS AND METHODS

This study was conducted in 2000 at the Agriculture Experiment Station on St. Croix, U.S. Virgin Islands (17° 43' N, 64° 48' W). Mean annual temperature was 79° F and total rainfall was below the 20-yr norm (Table 1). Guineagrass, Bluegrass and Suerte were planted on May 12<sup>th</sup> 2000 using a brillion seeder (4 x 6-m plots). A seeding rate of 4 kg ha $^{-1}$  for all grasses was used for this study. Bluegrass failed to establish and was eliminated from the study. The soil type was a

mildly alkaline Fredensborg clay (fine carbonatic, isohyperthermic, Typic Rendols, Mollisols) with a soil pH of 8.2.

The experiment was a randomized complete block in a split-plot arrangement with four replications. Main plot entries were local guineagrass, Bluegrass and Suerte (4 x 6-m). Subplots (4 x 2-m) were N rates of 0, 56, and 112 kg ha<sup>-1</sup>. Plants were allowed un-interrupted growth for 150 d and then clipped. Fertilizer as ammonium sulfate (36% N) was broadcast-applied on established stands which were cut-back to approximately 15-cm stubble height on 15<sup>th</sup> August 2000.

After cut-back, plants were monitored weekly and the date of first panicle emergence was recorded. The visual observations continued until a uniform panicle emergence area was observed (>60% of the experimental unit). Panicles were allowed to mature for an additional 21 d. Thereafter, for 7-d, panicle samples in the perimeter of the plot, were whipped across the palm of the hand until 50% of seed shattering was observed. This follows the procedure described by Kalmbacher *et al.* (1997). When 50% of seed maturity observed, panicles in 1-m<sup>2</sup> sections were harvested manually. The harvested panicles were sun and air-dried (12% moisture) and seed yield estimated (kg ha<sup>-1</sup>). Forage in the same 1-m<sup>2</sup> sections were harvested to determine DMY (Mg ha<sup>-1</sup>)

All data were analyzed using analysis of variance by PROC General linear methods (GLM; SAS, 1989). Means comparison, when significant, were made using single degree of freedom contrast for linear and quadratic effects for N rate.

## RESULTS AND DISCUSSION

Average annual rainfall in 2000 deviated from the norm (Table 1). Rainfall, however, was well-distributed from March to August allowing for adequate establishment of the grasses. Total rainfall for October and November was similar to the 20-yr norm.

Forage DMY for grass entries differed ( $P<0.05$ ). Guineagrass forage DMY averaged 8.1 Mg ha<sup>-1</sup> compared to 2.6 Mg ha<sup>-1</sup> for Suerte. This was a three-fold difference in DMY. The yield of guineagrass was consistent with 12-wk harvest in the U.S. Virgin Islands.

Dry matter yield of guineagrass remaining after seed harvest in 2000 increased linearly with increasing N rate. Guineagrass DM averaged 6.5, 8.3, and 9.4 Mg ha<sup>-1</sup> for the 0, 56, and 112 kg ha<sup>-1</sup> of N, respectively (Table 2). These forage yield were also consistent with those previously reported by Valencia *et al.* (2001) under grazing conditions. Suerte forage DM was not affected by N applications averaging 2.56 Mg ha<sup>-1</sup>. The lack of response of Suerte to N cannot be explained. Suerte recovery rate after clipping in mid-August was much more slower than guineagrass (E. Valencia; personal observations). This was despite that moisture was not limiting (2.7" of rainfall August, 2002; Table 1).

Grass entries did not differ ( $P<0.05$ ) on seed yield. Seed yield of guineagrass averaged 242 kg ha<sup>-1</sup> compared to 278 kg ha<sup>-1</sup> for Suerte. There was a trend, however, for increases in seed yield of guineagrass with increasing N rates and a quadratic response ( $P<0.05$ ) for Suerte. Seed yield of guineagrass averaged 180, 213, and 340 kg ha<sup>-1</sup> for the 0, 56, and 112 kg ha<sup>-1</sup> of N rate, respectively (Table 3). Seed yield of Suerte averaged 226, 300, and 306 kg ha<sup>-1</sup> for the 0, 56, and

112 kg ha<sup>-1</sup> of N rate, respectively (Table 3). The quadratic response of Suerte to N cannot be explained. Dwivedi et al. (1999) investigated the effect of varying N levels on seed production of *Setaria sphacelata* cv. Nandi, a tropical grass, and noted that seed yield (1000-seed weight) increased with N application. They attributed the seed yield to an increase in the number of fertile tillers (i.e., inflorescence). Similar responses were reported by Valencia et al. (2001). Research work by Hare et al. (1999) reported seed yield responses to N, but that plants were more susceptible to lodging. In this study, no effect of lodging was observed for either guineagrass or Suerte.

This study indicate that forage and seed yield of guineagrass was enhanced with N fertilization. In the case of Suerte, results for DMY and seed yield are not clear-cut. Timing of seed harvest for these tropical grasses are critical for optimizing seed yield. Under conditions of the U.S. Virgin Islands, higher rainfall during the months of September to November and strong easterly winds prior at the time of seed maturity to harvest of seed may affect yield of both grasses. Multiple harvests may be needed for these grasses to get a better estimate of seed yield and quality (pure live seeds).

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**Table 1. Monthly rainfall totals on St. Croix, US. Virgin Islands in 2000.**

Month	2000	Norm†
	-----inches-----	
January	3.23	2.40
February	2.93	1.61
March	1.01	1.65
April	0.97	2.28
May	1.80	3.70
June	0.82	2.36
July	2.38	2.99
August	2.72	4.40
September	2.21	5.98
October	6.80	5.07
November	3.86	5.59
December	1.91	3.66
Total	30.70	41.70

†Precipitation norm: 20-yr for St. Croix, USVI.

**Table 2. Effect of N rates on forage dry matter (DM) of guineagrass and Suerte at St. Croix, USVI in 2000.**

Grass entry	N rates (kg ha <sup>-1</sup> )			F test†	SE‡
	0	56	112		
	-----DM Mg ha <sup>-1</sup> -----				
Guineagrass	6.5	8.3	9.4	L*	0.83
Suerte	3.1	2.2	2.4	NS	0.83

\*Significant at 0.05 probability level.

†Linear (L) effect of N effects.

‡Standard error (SE).

**Table 3. Effect of N rates on seed yield of guineagrass and Suerte at St. Croix, USVI in 2000.**

Grass Entry	N rates (kg ha <sup>-1</sup> )			F test†	SE‡
	0	55	112		
	-----kg ha <sup>-1</sup> -----				
Guineagrass	180	213	340	P=0.10	61.7
Suerte	226	300	306	Q*	61.7

\*Significant at 0.05 probability level.

†Linear (L) effect of N effects.

‡Standard error (SE).